I – Problem Statement Title (04-GS065)

Improving Excavatable Flowable Backfill with Recycled Materials

II – Research Problem Statement

Question: How can we use recycled materials to aid in controlling the long-term strength gain of flowable backfill while reducing the amount of natural resources being used and the amount of materials being diverted to landfills?

Identify and evaluate recycled materials and industrial by-products which can serve as replacement for cement or aggregate in flowable fills in California. Flowable fills, also called controlled low strength material and slurry cement backfill, is used in place of labor intensive compacted backfills. Flowable fills are frequently difficult to excavate, so many states are re-evaluating their specifications. Recycled materials and industrial by-products have been used to help control the long-term strength gain. However, the primary materials being used, fly ash and foundry sands, are not local to California. Specifications for reliable flowable fills which utilize local recycled materials are needed to equip engineers with better materials to use while supporting a sustainable California.

III – Objective

The objective of this research is to develop guide specifications for mixture proportions of flowable fills which utilize local recycled materials or industrial by-products. The specifications should identify materials which regionally available and establish mixture proportions for flowable fills which economically utilize these materials. The recommended mixture proportions should be established through laboratory investigations, and their performance confirmed through field trials.

IV – Background

Excavatable flowable fills are self-compacting cement based slurries used as substitutes for compacted backfill in utility trench cuts and other fill applications. They should gain enough early strength within about four hours to allow pavement to be placed over it without subsidence. It should not gain so much strength in the long term that it cannot be easily excavated by a backhoe. However, they frequently gain too much strength making re-excavation problematic. Recent research in other states has investigated industrial by-products and recycled materials to help control the long-term strength gain. Twenty states have specifications which include fly ash in flowable fills. Ohio and Pennsylvania DOTs already allow spent foundry sands in their specifications. Other states are investigating dredge materials and other reclaimed materials.

V – Statement of Urgency and Benefits

A. Support of the Department's Mission/Goals: (Improving Mobility: Safety, Reliability, Performance and Productivity)

Enhanced **PERFORMANCE** will result from establishing better specifications for flowable fill. This will result in lower project cost. It will reduce the amount of physical labor used for backfilling. In larger applications it will increase **PRODUCTIVITY**. It may allow the opening of roads to traffic quicker since flowable fills can be placed faster than compacted backfill. Lastly, utilizing recycled materials or industrial by-products which are local to California will reduce demands on our natural resources while placing less material into landfills.

B. Return on Investment (ROI)

The ROI can't be quantified in dollars alone for this proposal. Diverting and/or recycling materials destined for landfills throughout the State is priceless.

VI – Related Research

- ACI Committee 220, "Controlled Low-strength Materials (CLSM)," American Concrete Institute, Farmington Hills, MI, 1999.
- NCHRP Project 24-12(01), "Controlled Low-Strength Material for Backfill, Utility Bedding, Void Fill, and Bridge Approaches," conducted by K. Folliard at Univ. Texas, Austin is nearing completion.
- Bhat, S. T., and Lovell, C. W., "Use of Coal Combustion Residues and Waste Foundry Sands in Flowable Fill," FHWA Report No. JHRP-96/2, sponsored by the Indiana Department of Transportation.
- "Controlled Low-Strength Materials," ACI SP-150, edited by W. S. Adaska, Farmington Hills, MI, 1994. This is a collection of six papers covering different aspects and applications of flowable fills.

VII – Deployment Potential

This research will result in specifications for flowable fills with improved performance, specifically better limiting the long term strength gain, while diverting materials from landfills. It will save time and money by encouraging use of flowable fill in place of the more labor intensive compacted fill while helping California better manage its natural resources.